

CLAIMS

1. In a nonaqueous electrolyte secondary battery including a positive electrode containing a positive active material, a negative electrode containing a negative active material and a nonaqueous electrolyte,

said secondary battery being characterized in that said positive active material comprises a lithium transition metal oxide containing Li and Co and having a layered structure and further comprises a group IVA element and a group IIA element of the periodic table.

2. The nonaqueous electrolyte secondary battery as recited in claim 1, characterized in that said group IVA element adheres as a compound to a surface of said lithium transition metal oxide.

3. The nonaqueous electrolyte secondary battery as recited in claim 2, characterized in that said compound of the group IVA element exists in the form of particles adhered to the surface of said lithium transition metal oxide.

4. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 3, characterized in that said group IVA element is at least one of Zr, Ti and Hf and said group IIA element is Mg.

5. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 3, characterized in that said group IVA element is Zr and said group IIA element is Mg.

6. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 5, characterized in that said group IVA element and group IIA element are contained substantially in the equimolar amounts.

5 7. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 6, characterized in that said positive active material comprises lithium cobaltate containing said group IVA element and group IIA element.

10 8. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 7, characterized in that said group IVA element and group IIA element are contained in said positive active material in the total amount of not greater than 3 mole %, based on the total amount of the aforementioned elements and the transition metal in the lithium transition metal oxide.

15 9. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 8, characterized in that said positive active material has a specific surface area of not greater than 1.0 m²/g.

20 10. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 9, characterized in that said positive active material and said negative active material other than metallic lithium are contained such that when an end-of-charge voltage is prescribed at 4.4 V, a ratio in charge capacity of the negative electrode to the positive electrode
25 is 1.0 - 1.2.

11. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 10, characterized in that said nonaqueous electrolyte contains a cyclic carbonate and a chain carbonate, as a solvent, and the cyclic carbonate content of the solvent is 10 - 30 % by volume.

12. The nonaqueous electrolyte secondary battery as recited in any one of claims 1 - 11, characterized in that said positive electrode contains, as an electrical conductor, a carbon material in the amount not to exceed 5 % of the total weight of the positive active material, the conductor and a binder.

13. A method of using a nonaqueous electrolyte secondary battery characterized in that a nonaqueous electrolyte secondary battery including a positive electrode containing a positive active material, a negative electrode containing a negative active material and a nonaqueous electrolyte is charged at an end-of-charge voltage of at least 4.3 V, said positive active material comprising a lithium transition metal oxide containing Li and Co and having a layered structure and further comprising a group IVA element and a group IIA element of the periodic table.

14. The method of using a nonaqueous electrolyte secondary battery as recited in claim 13, characterized in that said group IVA element adheres as a compound to a surface of said lithium transition metal complex oxide.

15. The method of using a nonaqueous electrolyte secondary battery as recited in claim 14, characterized in that said

compound of the group IVA element exists in the form of particles adhered to the surface of said lithium transition metal complex oxide.

16. The method of using a nonaqueous electrolyte secondary
5 battery as recited in any one of claims 13 - 15, characterized in that said group IVA element is at least one of Zr, Ti and Hf and said group IIA element is Mg.

17. The method of using a nonaqueous electrolyte secondary
battery as recited in any one of claims 13 - 15, characterized
10 in that said group IVA element is Zr and said group IIA element is Mg.

18. The method of using a nonaqueous electrolyte battery
as recited in any one of claims 13 - 17, characterized in that
said group IVA element and group IIA element are contained
15 substantially in the equimolar amounts.

metal complex oxide contains substantially the same amount of nickel and manganese.